

CLAIMS

What is claimed is:

1. A method for use in rate controlling an activity, the method comprising:
identifying an approximated inverse rate, a fix-up adjustment value, and a
5 quantum;
maintaining an activity measurement value based on a measure of activity;
maintaining a rate control value based on the measure of activity and the
approximated inverse rate;
applying the fix-up adjustment value once each said quantum to the rate control
10 value to maintain rate accuracy of the activity.
2. The method of claim 1, wherein the activity includes sending packets of a
stream of packets.
3. The method of claim 2, wherein the measure of activity is a number of bytes or
packets sent.
- 15 4. The method of claim 2, wherein the rate control value is a scheduling value
used for determining the relative ordering or timing of a next one or more packets of the
stream of packets.
5. The method of claim 1, wherein said applying the fix-up adjustment value once
each quantum to the rate control value includes dithering the rate control value to either
20 round-up or not to round-up the rate control value based on a random number.

6. A computer-readable medium containing computer-executable instructions for performing steps for rate controlling an activity, said steps comprising identifying an approximated inverse rate, a fix-up adjustment value, and a quantum;
- 5 maintaining an activity measurement value based on a measure of activity; maintaining a rate control value based on the measure of activity and the approximated inverse rate; applying the fix-up adjustment value once each said quantum to the rate control value to maintain rate accuracy of the activity.
- 10 7. The computer-readable medium of claim 6, wherein the activity includes sending packets of a stream of packets.
8. The computer-readable medium of claim 7, wherein the measure of activity is a number of bytes or packets sent.
9. The computer-readable medium of claim 7, wherein the rate control value is a scheduling value used for determining the relative ordering or timing of a next one or more packets of the stream of packets.
- 15 10. The computer-readable medium of claim 6, wherein said applying the fix-up adjustment value once each quantum to the rate control value includes dithering the rate control value to either round-up or not to round-up the rate control value based on a random number.
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11. An apparatus for use in rate controlling an activity, the apparatus comprising:
means for identifying an approximated inverse rate, a fix-up adjustment value, and
a quantum;
means for maintaining an activity measurement value based on a measure of
5 activity;
means for maintaining a rate control value based on the measure of activity and
the approximated inverse rate;
means for applying the fix-up adjustment value once each said quantum to the rate
control value to maintain rate accuracy of the activity.
- 10 12. The apparatus of claim 11, wherein the activity includes sending packets of a
stream of packets.
13. The apparatus of claim 12, wherein the measure of activity is a number of
bytes or packets sent.
14. The apparatus of claim 12, wherein the rate control value is a scheduling value
15 used for determining the relative ordering or timing of a next one or more packets of the
stream of packets.
15. The apparatus of claim 11, wherein said means for applying the fix-up
adjustment value once each quantum to the rate control value includes: means for
dithering the rate control value to either round-up or not to round-up the rate control
20 value based on a random number.

16. A method for use in scheduling packets, the method comprising:
identifying in a current slot a scheduling item corresponding to a packet;
identifying an approximated inverse rate, a fix-up adjustment value, and a
quantum value corresponding to the scheduling item;
5 identifying a last adjusted slot for the scheduling item;
adjusting a bytes sent value based on a number of bytes of the packet to identify a
new bytes sent value; and
in response to identifying that the bytes sent value is greater than or equal to a
quantum value corresponding to the scheduling item: (a) identifying a new last adjusted
10 slot for the scheduling item, said identifying the new last adjusted slot including summing
a product of the approximated inverse rate and the quantum value, the fix-up adjustment
value, and the last adjusted slot; and (b) determining a next slot for the scheduling item,
said determining the next slot including adding the product of the approximated inverse
rate and the new bytes sent value to the new last adjusted slot.
- 15 17. The method of claim 16, wherein said identifying the last adjusted slot for the
scheduling item includes subtracting the product of the approximated inverse rate and the
bytes sent value from the current slot.
18. The method of claim 16, wherein the fix-up adjustment value is determined
20 based on the error induced by the approximated inverse rate during a quantum
corresponding to the scheduling item.
19. The method of claim 16, comprising: in response to identifying that the bytes
sent value is less than a quantum value corresponding to the scheduling item, determining
the next slot including adding the product of the approximated inverse rate and the new
bytes sent value to the last adjusted slot.

20. The method of claim 16, wherein said identifying the new last adjusted slot for the scheduling item includes dithering the new last adjusted slot to either round-up or not to round-up the new last adjusted slot based on a random number.

21. An apparatus for use in scheduling packets, the apparatus comprising:

5 means for identifying in a current slot a scheduling item corresponding to a packet;

means for identifying an approximated inverse rate, a fix-up adjustment value, and a quantum value corresponding to the scheduling item;

means for identifying a last adjusted slot for the scheduling item;

10 means for adjusting a bytes sent value based on a number of bytes of the packet to identify a new bytes sent value; and

means for in response to identifying that the bytes sent value is greater than or equal to a quantum value corresponding to the scheduling item: (a) identifying a new last adjusted slot for the scheduling item, said identifying the new last adjusted slot including

15 summing a product of the approximated inverse rate and the quantum value, the fix-up adjustment value, and the last adjusted slot; and (b) determining a next slot for the scheduling item, said determining the next slot including adding the product of the approximated inverse rate and the new bytes sent value to the new last adjusted slot.

22. The apparatus of claim 21, wherein said means for identifying the last adjusted slot for the scheduling item includes means for subtracting the product of the approximated inverse rate and the bytes sent value from the current slot.

23. The apparatus of claim 21, wherein the fix-up adjustment value is determined based on the error induced by the approximated inverse rate during a quantum corresponding to the scheduling item.

24. The apparatus of claim 21, comprising: means for in response to identifying that the bytes sent value is less than a quantum value corresponding to the scheduling item, determining the next slot, which includes adding the product of the approximated inverse rate and the new bytes sent value to the last adjusted slot.

5 25. The apparatus of claim 21, comprising: means for computing the approximated inverse rate and the fix-up adjustment value.

26. The apparatus of claim 21, wherein said identifying the new last adjusted slot for the scheduling item includes dithering the new last adjusted slot to either round-up or not to round-up the new last adjusted slot based on a random number.

10 27. A computer-readable medium containing computer-executable instructions for performing steps for use in scheduling packets, said steps comprising:

identifying in a current slot a scheduling item corresponding to a packet;

identifying an approximated inverse rate, a fix-up adjustment value, and a quantum value corresponding to the scheduling item;

15 identifying a last adjusted slot for the scheduling item;

adjusting a bytes sent value based on a number of bytes of the packet to identify a new bytes sent value; and

in response to identifying that the bytes sent value is greater than or equal to a quantum value corresponding to the scheduling item: (a) identifying a new last adjusted slot for the scheduling item, said identifying the new last adjusted slot including summing a product of the approximated inverse rate and the quantum value, the fix-up adjustment value, and the last adjusted slot; and (b) determining a next slot for the scheduling item, said determining the next slot including adding the product of the approximated inverse rate and the new bytes sent value to the new last adjusted slot.

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28. The computer-readable medium of claim 27, wherein said identifying the last adjusted slot for the scheduling item includes subtracting the product of the approximated inverse rate and the bytes sent value from the current slot.

5 29. The computer-readable medium of claim 27, wherein the fix-up adjustment value is determined based on the error induced by the approximated inverse rate during a quantum corresponding to the scheduling item.

30. The computer-readable medium of claim 27, comprising: in response to identifying that the bytes sent value is less than a quantum value corresponding to the scheduling item, determining the next slot including adding the product of the
10 approximated inverse rate and the new bytes sent value to the last adjusted slot.

31. The computer-readable medium of claim 27, wherein said identifying the new last adjusted slot for the scheduling item includes dithering the new last adjusted slot to either round-up or not to round-up the new last adjusted slot based on a random number.

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